

DECISION SUPPORT FRAMEWORK (DSF) FOR PLANNING LAND AND RESOURCE USE TO SUSTAINABLY MAINTAIN HEALTHY ECOSYSTEM SERVICES AND COMMUNITIES

DECISION SUPPORT FRAMEWORK TEAM

Ecosystem Services Research Program (ESRP)

Presented by Ann Vega (EPA), Pat
Bradley (EPA), and Amanda Rehr (CMU)

ESRP Seminar Series
March 30, 2009 – Cincinnati, OH

ESRP – Big Picture

- 5 Place-Based Projects: Willamette, Tampa Bay, Future Midwestern Landscapes (FML), Coastal Carolinas, Southwest
- 2 Ecosystem Specific Studies: Wetlands, Coral Reefs
- 1 Pollutant Specific Study: Nitrogen
- 7 Cross-Program Themes: Mapping, Monitoring, Modeling, Human Well-Being, Valuation, Outreach and Education, **Decision Support Framework**

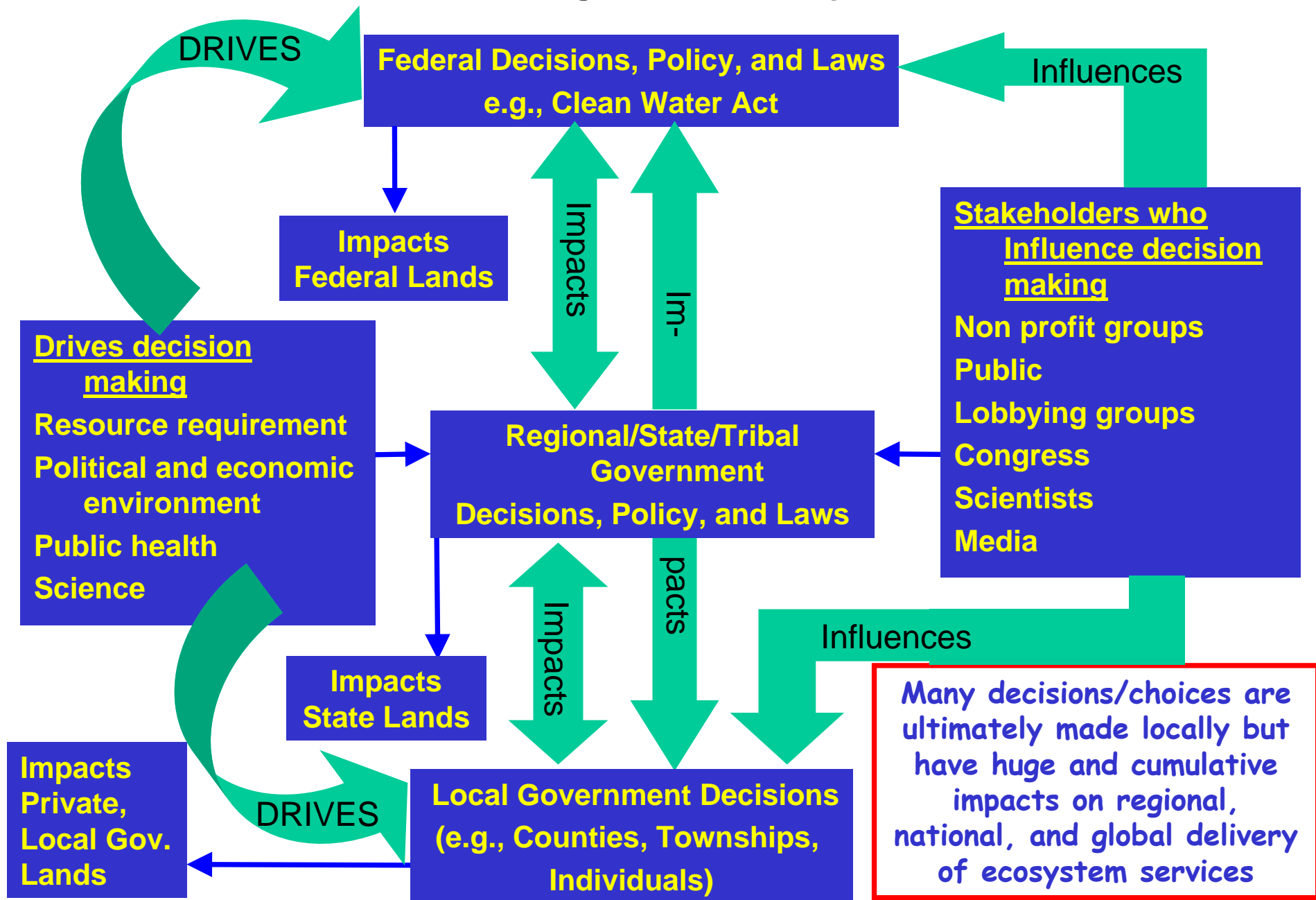
ESRP Vision, Mission, Goal

- **Vision:** Contribute to a comprehensive theory and practice for characterizing, quantifying, and valuing ecosystem services, to ensure that their relationship to human well-being is consistently incorporated into environmental decision making.
- **Mission:** Provide the information and methods needed by decision makers to assess the benefits of ecosystem goods and services to human well-being for inclusion in management alternatives.
- **Goal:** To transform the way decision makers understand and respond to environmental issues by making clear the ways in which our policy and management choices affect the type, quality and magnitude of the goods and services we receive from ecosystems.

Long Term Goal 1 (from MYP)

- **Effective Decision Support.** By 2014 ERP will provide innovative, [online](#) decision support that offers [EPA, Regions, States, local communities and resource managers](#) the ability to integrate, visualize, and maximize use of diverse data, models and tools at [multiple scales](#) to generate alternative decision options and to understand the consequences of management decisions on the [sustainability of ecosystem services, their value, and human well-being](#).
- Includes Decision Support Framework, Outreach & Education, Valuation and Human Well-Being

Decision Making Occurs at Multiple Levels



Evolution of the DSF

- Multi-Year Plan
- Scientific Advisory Board (SAB) Review
- SAB Quality Reviewer
- Clarification of Direction
- DS Platform->DS Framework

DSF Implementation Plan (IP)

APM 372 (2009):

Produce a peer-reviewed decision support framework (DSF) research and implementation plan.

- Went out for external review 10/28/08 to 11 people
- Received 3 responses
- Revised approach partially described in this presentation (working on revising implementation plan and multi-year plan)

2008 SAB Advisory Report Recommendation

"Improve dramatically the integration of economics and the decision and behavioral social sciences into research and policy development across the Agency.While the agency has reasonable staff resources in economics, and maintains some research on issues in environmental economics, its capability in the behavioral social sciences, and decision sciences, is so limited that it typically is not even in a position to ask the right questions."

SAB (2008). SAB Advisory Report "EPA's Strategic Research Directions 2008." November 26, 2008, EPA-SAB-09-006.

Approach – Increasing Capability

- New Hires: Decision Analysis/Probabilistic Modeling; Economist
- Cross-ORD Post-Docs: Valuation/Decision Support; Decision Analyst (DA)
- Experts and Partners
 - Mitch Small (DS/DA expert)
 - Amanda Rehr (DS/DA expert)
 - Peter Shuba (Stakeholder Involvement expert)
 - John Bolte (DS/Modeler expert)
 - Mark Judson (IT expertise - partner)
 - Allyson Beall (Stella Model/Stakeholder Involvement expert)
 - EBM Tools Network
 - Neptune and Company; Shaw (DA/DS/Modeling contractors)

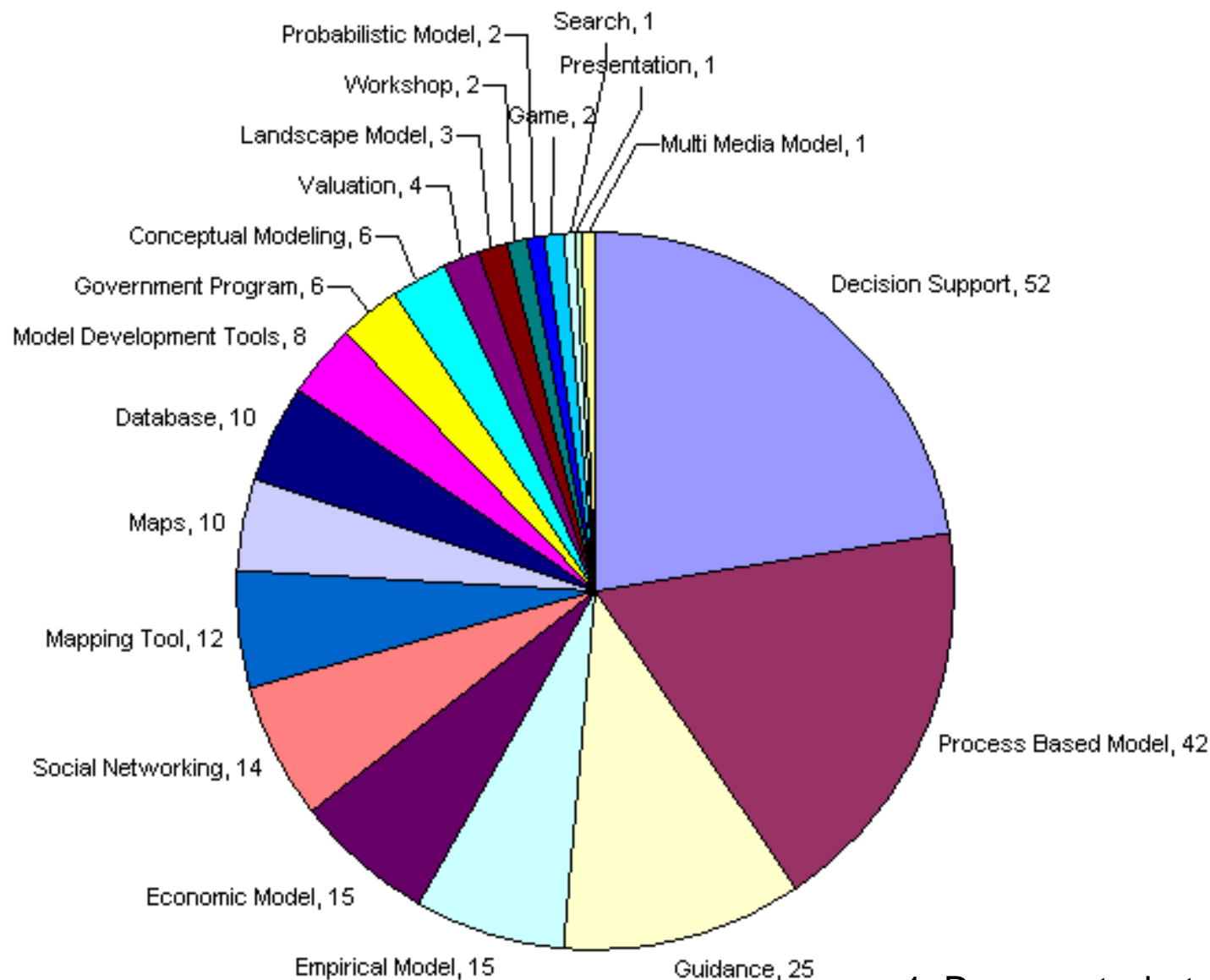
Approach – Learning by Doing

1. Document what we know: Review existing tools and collect information in a database.
2. Identify what decision-makers and stakeholders want/need: Concurrent with 1, gather information from decision-makers and stakeholders through workshops and from existing documentation.
3. Use analytic-deliberation to begin to integrate scientific information with decision-maker/stakeholder values and to help determine what we don't know.
4. Target research and tools to meet needs of decision-makers: Evolve the conceptual model.

What We Know: Existing Tools Database

APM 374 (2009):

Develop a database of characteristics of existing information, tools, approaches and techniques both electronic and non-electronic in concert with stakeholder/user inputs via outreach and education and the ESRP teams (content developers) to assist in the design of the DSF architecture.



Microsoft Access

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General Info

General Info Table

Ag to Urban Ecosystems

AGNPS
ANSWERS
AquaSea
AQUATOX
ARAMS
ARIES
ATILA
BASINS
BASS
BBOP
BBT
BenMap
Buy, Sell, Trade!
CADDIS
CADRe
CAIT
Carbon Trust Tools
CBNRM
C-CAP
CDL
CENTURY
CGCM
CITYgreen
CLIGEN
C-map
CMAQ
COAST
COMBO
ComMod
Conservation Economy - The I
CoRTAD
Cow Culling DSS
CPCW
CRE
CSMoS

Tool Name From Agricultural to Urban Ecosystems: Nature's Services to Humankind

Acronym Ag to Urban Ecosystems

Developer Blue Sky Broadcast **Submitted By** Ann Vega

Website URL http://live.blueskybroadcast.com/bsb/client/CL_DEFAULT.asp?Client=122&PCAT=760&CAT=1056&

Demo URL

Contact Name Katherine Gross **Phone** 269-671-2235

Email grossk@kbs.msu.edu **Alternate Email**

Address W.K Kellogg Biological Station
Michigan State University

Development Status 6_mature

Product Type Series of Presentations **Keywords** Ecosystem Services, Agricultural Ecosystems, Urban Ecosystems

Description Ecosystems provide people with innumerable and invaluable services. Our increasing need for food, fiber, and fuel has increased awareness of the importance of ecosystems, the services they provide, and the ways in which we depend on them. Join leading researchers as they provide information that will be of tremendous value to policy makers, students, and anyone interested in learning more about our nation's valuable resources.

Freely Available ☒ **Approximate Cost** **Transferability Locations** Easily done

Created Date 1/26/2009 **Updated Date** 1/26/2009 **QA Exempt** No

Notes This is a series of presentations on Ecosystems services that are provided by Agricultural and Urban environments. These presentations provide information on how climate change and other regulating factors affect resulting ecosystem services. These papers are designed to be applicable to large geographic areas. No valuation information in these papers.

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Record: 2 of 236

Form View

User Information
Ecosystem Type
IT Details
Tool Category
Team Interests
ESRP Needs
Ecosystem Services

1. Document what we know

Microsoft Access

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Type a question for help

dsfTools_relational - Database (Access 2002 - 2003 file format)

General Info

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User Information Table

Tool Name From Agricultural to Urban Ecosystems: Nature's Services to Humankind

Educator ☐ **IT Expertise** Basic computer skills

Engineer ☐ **Scientific Expertise** General understanding of issue

Model Developer ☐ **Resource Requirements**

Model User ☐ **Visualization** ☐

Nontechnical Decision Maker ☐ **Used for Project** ☐

Other ☐ **Related Tools**

Scientist ☒ **Information Source** Tool website

Student ☒ **Feedback Method**

Technical Decision Maker ☒ **Audience Success** ☐

Assumptions Valid ☐

Intuitive Use ☐

Tutorial Available ☐

Information Easy ☐

Decision Type Alternative futures

Decision Type: Series of papers Looking at Ecoservices

Time Stamp 2/12/2009 3:27:23 PM **Set Time Stamp**

User Information

Ecosystem Type

IT Details

Tool Category

Team Interests

ESRP Needs

Ecosystem Services

Form View

1. Document what we know

User Interface

Database

Applet Viewer: DSFToolsApplet.class

Applet

Decision Type

Alternative Futures ▼

User Information

Your Role: Educator ▼

Technical Expertise: Basic computer skills ▼

Scientific Background: Some science ▼

Operating System: Windows ▼

Ecosystem Type

☒ Agricultural Land ☐ Coral Reef

☐ Desert ☐ Estuary

☒ Forest ☒ Lake/Pond

☒ Grasslands ☐ Marine

☐ Outer Continental Shelf ☒ Prairie

☐ River ☐ Savanna

☐ Terrestrial ☐ Urban

☐ Freshwater Wetland ☐ Coastal Wetland

Features

☒ Visual Outputs

☐ Tutorials

☒ Web Based

☒ Desktop

☐ Hardcopy Based

☐ Open Source

Attributes

☐ Valuation ☐ Social Networking

☒ Societal Values ☐ Physically Based

☐ Empirical ☐ Semiempirical

Submit Query

Results

- CBNRM
 - Community-Based Natural Resource Management Network
 - Worldwide people working on Community-Based Natural Resource Management (CBNRM), as practitioners, managers and researchers
 - #http://www.cbnrm.net/index.html#
- Learner.org
- Marine Biodiversity Wiki
- MARKAL
- MCAT
- MIDAS

Applet started.

What we Know: Challenges

- Decision-makers are already making decisions
- Decision-makers are generally overworked and under-funded
- Decision-makers' responsibilities and authorities are often narrowly defined

Therefore, decisions are often made “out of context” – not looking at entire system.

Who Are the Decision-Makers?

- Policy-makers (all scales)
 - Develop laws and regulations
- Regional/State/Territorial/Tribal
 - Environmental Managers
 - Natural Resource Managers
- Local Government
 - Land-Use Planning, Permitting, Zoning
- Public and Other Stakeholders

Identify What Decision-Makers Want

- Visioning – what's important
- Understanding key decisions and decision-making processes
- Understanding decision-maker/stakeholder comfort/facility with various types of tools

Multiple approaches to collect information

- Mining Information from Documents/Web
- Workshops
- Interviews
- Surveys (would need OMB approval)

Coastal Carolinas Workshop

Issue: “Unbridled Development”

- Local land use decisions are made without any reference to a region or area – no regional planning exists
- Decisions are site-specific, yet can impact the region tremendously, and hence, ecosystem services
- Specific example: boat dock permits **MUST** be issued if the specific action does not exceed a regulatory threshold (even if a combination of permitted actions do)
- “Death by a thousand cuts”

Decision Support for Coral Reefs

- Goal: Provide the tools and information to ensure that the **full value** of coral reef ecosystem services is **routinely incorporated** into all levels of management and decisions made in the reef *watershed* and *coastal zone*
- Coral Reef Ecosystem Services
 - Regulating (*shoreline protection*, water quality maintenance, climate regulation)
 - Provisioning (*fish*, pharmaceuticals, chemicals)
 - Cultural (*tourism, recreation*, spiritual)
 - Supporting (cycling nutrients, nursery habitats, *biodiversity*)

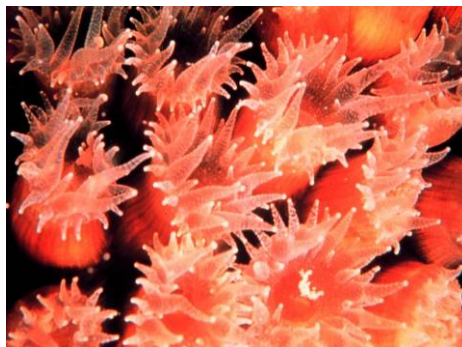
Coral Reef Decision Workshops

- **Prior Workshop (2007)**
 - **US Virgin Islands**
- **Planned Workshops (2009 – 2010)**
 - **Florida Keys**
 - **SE Florida (Miami-Dade – Martin counties)**
 - **Puerto Rico**



What do we learn from the workshops?

- **Visions for the coral reef ecosystem**
 - How we might attain that vision and obstacles to overcome
- **Understanding decisions; what are they, who makes them, what is the process, and what information is used?**
 - Current use of data, information and tools
 - Comfort/facility with various types of tools
- **How to target research and tools to meet needs of DMs**



Questions Posed by Decision-Makers

FML Example

Local Scale

What can I do to protect water quality on my property?

How can I attract more wildlife (e.g. songbirds)?

How can community zoning ensure adequate green space?

How many people can our available water resources supply?

How can we reduce traffic congestion in developing neighborhoods?

Regional Scale

How do we target watersheds for improving water quality most efficiently? Which linkages among watersheds are the most critical for reducing pollution downstream?

How can this region accommodate an increasing population and maintain good air quality?

Where are the areas most vulnerable to multiple stresses?

How effective are local conservation measures in protecting migratory bird stopovers?

How effective are local BMPs in protecting large water bodies?

National Scale

What policies are needed to reduce the hypoxic zones in the Gulf of Mexico and Lake Erie?

How do we ensure adequate habitat for federally protected migratory species?

How do we evaluate areas to optimize the production of ecosystem services through programs such as the Conservation Reserve Program?

What restoration methods work where?

How can we quantify the success of environmental protection legislation?

One Approach: The Decision Landscape

- Definition: the physical, legal, and institutional environment in which a management choice is made
- Recognizes that various people provide inputs to environmental decisions in different ways and inputs evolve over time along with state of the ecological system
- Each element of decision landscape has implications for choosing appropriate decision-support methodology and tools and for selecting preferred management strategies

Framework for Characterizing Decision Landscape

1. Who is involved in making decisions (rule makers, managers, information collectors, impacted stakeholders)?
2. What are the management/decision options (things managers/decision makers can control)?
3. What are outcomes (and ecosystem services) we care about (and corresponding metrics)?
4. What are the external variables (things managers cannot control that provide basis for uncertainty analysis)?
5. What are methods that can be used to do assessment?

Example Scenario: Cruise Ships in Key West

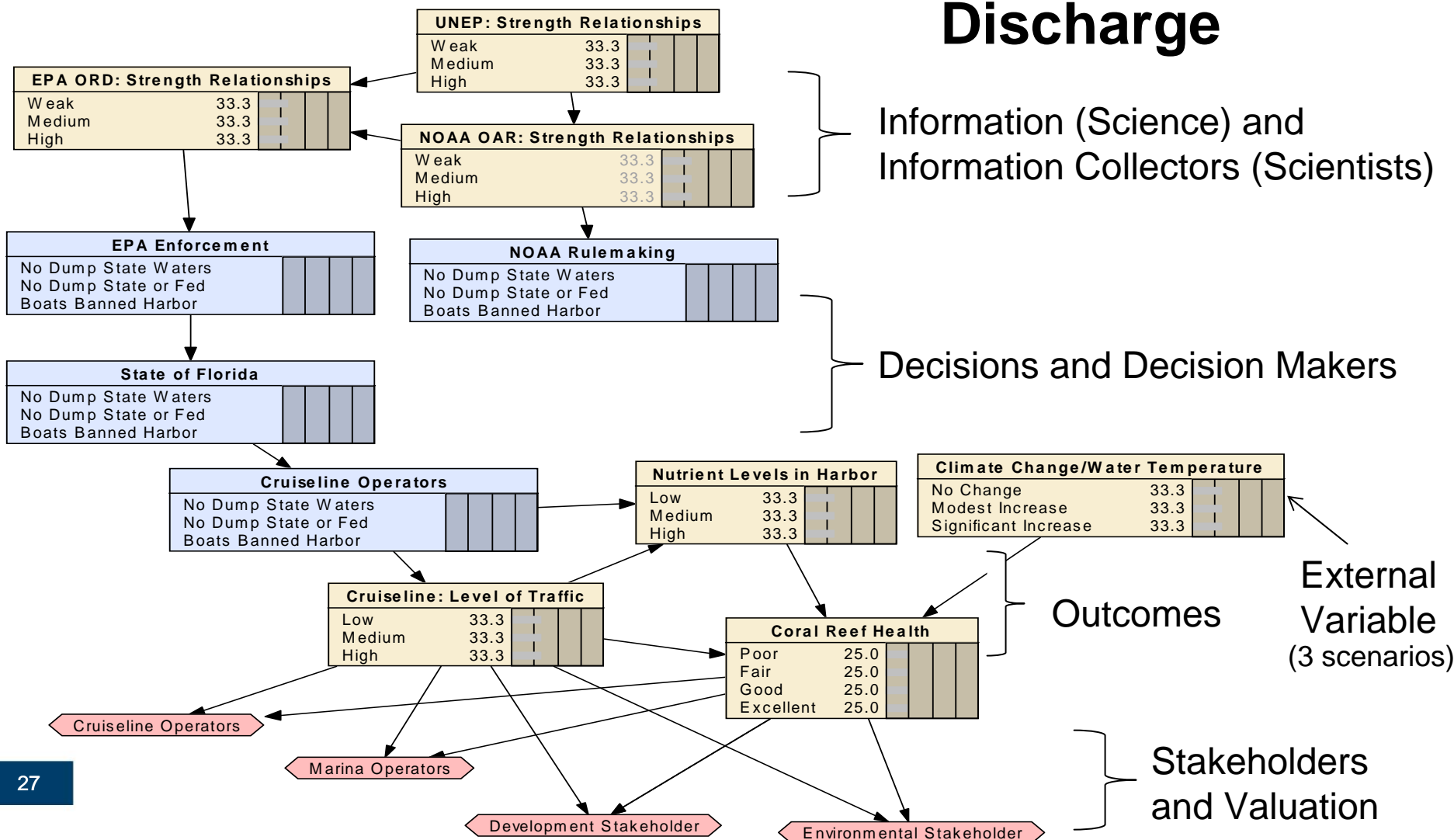
Source of Economic Growth

- \$\$\$
- 500 cruise ships/yr
- ~1 million passengers/yr
- Per head fee to city
- Passenger spends \$75-100/day
- 30% employment base for tourism industry

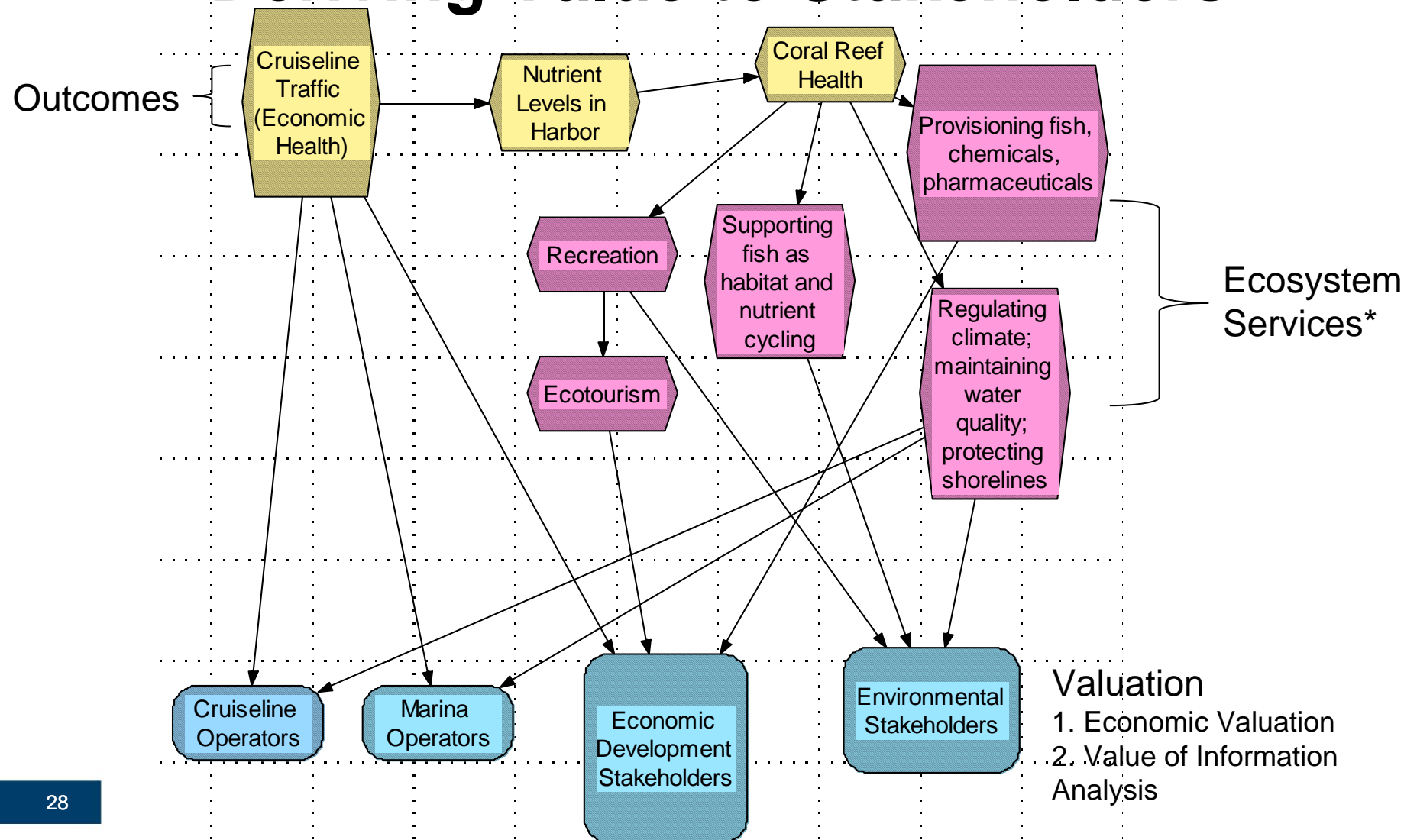
Source of Coral Reef Degradation

- Discharging oil, untreated wastewater, sewage, toxic chemicals, hazardous waste, plastics and garbage, oil/fuel
- Damaging reefs by hitting and scraping
- Stirring up sediments

Example Decision Landscape: Boat Sewage Discharge



Deriving Value to Stakeholders



Determine what we know we don't know and what we don't know we don't know

Where are there gaps in the scientific information?

- Why do land and resource use decisions typically ignore consideration of sustaining ecosystem services?
- Which analytic-deliberative process(es) should be used for which situations?
- For each situation, what are decision-maker/stakeholder values/preferences? Needs? Decision-making processes? Capabilities? Limits/Boundaries? Regulations/Policies? Authority? Scales of relevant ecosystem services; stressors?
- How do we create a decision support framework that increases the capacity for better decisions at all scales?

Learn what we don't know we don't know by doing

3. Use Analytic Deliberation

Target Tools to Decision-Makers' Needs

- Flow chart decision-making processes
- A variety of use cases
- Continuous decision-maker/stakeholder involvement and interaction
- An example from ReVA resulted in a Decision Support Tool that had 3 levels of users:
 - Management (canned indices, quick answers),
 - Planners (ability to query data for specific endpoints), and
 - Analysts (access to all DST capabilities, ability to modify data).

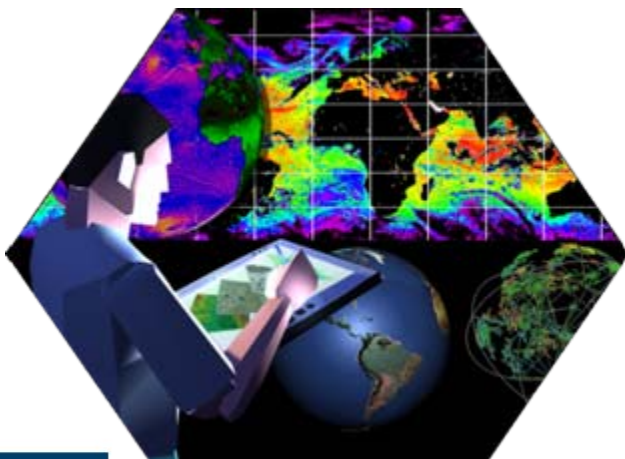
Proposed Purpose of the Decision Support Framework

Employ scientific methods of mapping, monitoring and modeling

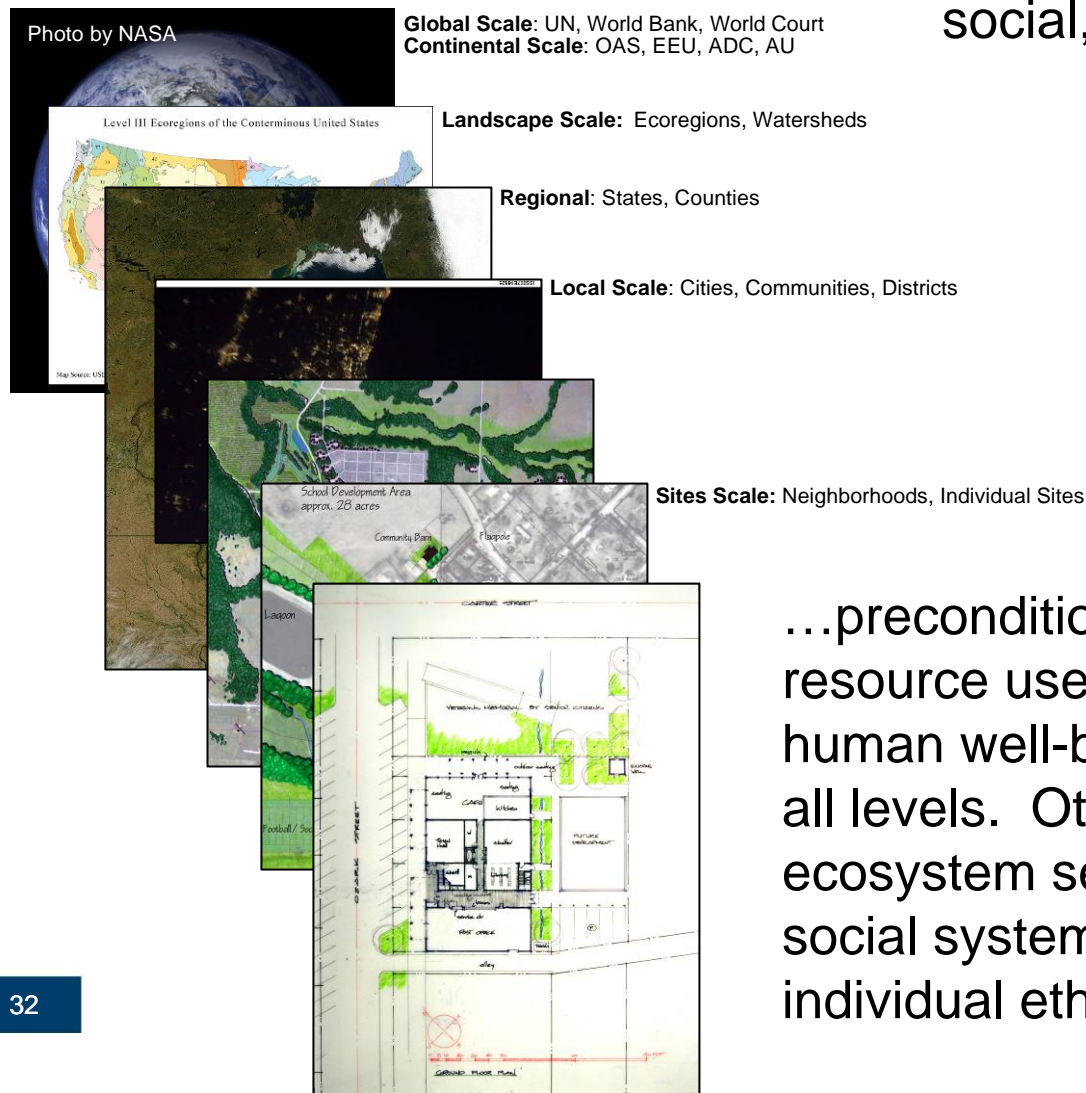


To assist decision-makers at the local, tribal, state, regional, and national levels

With decision support for land and resource use planning



To achieve sustainable economic, social, and ecological systems...



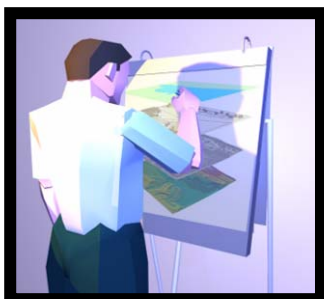
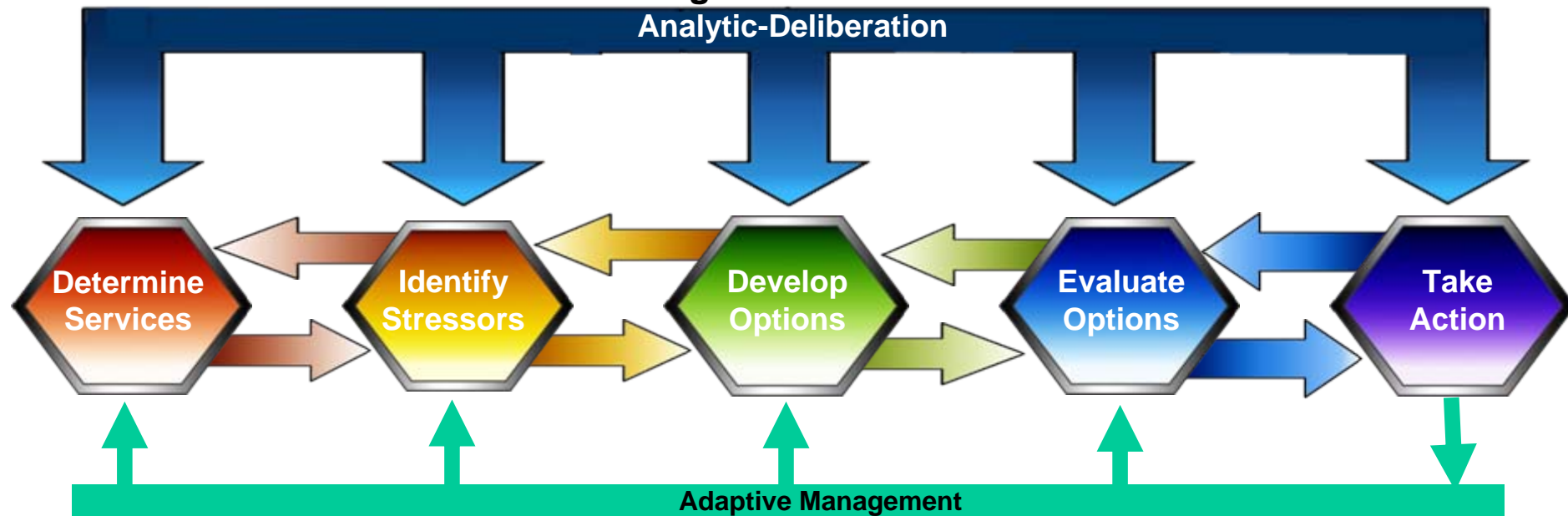
...preconditions of sustainable land and resource use, economic viability, and human well-being need to be defined at all levels. Otherwise, achieving healthy ecosystem services (and economic and social systems) is dependent upon individual ethics or values.

Evolve Conceptual Model

APM 375 (2009):

Develop conceptual model for the Decision Support Framework (DSF).

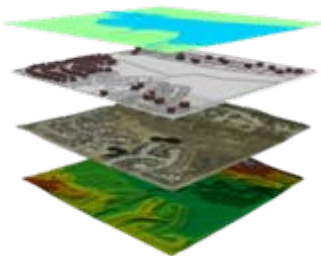
A Framework for Making Land and Resource Use Decisions



Define region, map current uses and capacity of services



Identify Stressors



Develop sustainable land and resource use options



Negotiate inputs, evaluate, determine path forward, begin to implement



Carry out plan with adaptive management

DSF Liaisons - Projects

- Wetlands: Tim Canfield, Walter Berry, Jan Keough (TL)
- Coral Reefs: Pat Bradley, Norma Lewis, Bill Fisher (TL)
- Willamette: Dave Hammer (TL)
- Tampa Bay: Linda Harwell, Verle Hansen, Marc Russell (TL)
- FML: Betsy Smith (TL), Curtis Cooper, Randy Bruins (TL)
- Coastal Carolinas: Drew Pilant, Norma Lewis, Dorsey Worthy (TL)
- SouthWest: Nita Tallent-Hassell (TL)
- Nitrogen: Jana Compton (TL)

DSF Liaisons - Themes

- Modeling: Rajbir Parmar, Kurt Wolfe
- Monitoring: Mike McDonald (TL)
- Mapping: Annie Neale (TL)
- Outreach and Education: Suzanne Marcy (TL)
- Human Well-Being: Laura Jackson (TL)
- Valuation: Economic Network

Additional DSF Team Member Roles

- Herb Fredrickson – Associate Director for Eco/Team Owner
- Gordon Evans – Assistant Lab Director for Eco
- Ann Vega – Team Lead; OSWER Liaison
- Tim Canfield – Backup Team Lead
- Bill Barrett – IT Lead
- Heidi Paulsen – VisLab Support
- Bart Faulkner – Existing Tool Database Lead
- Dave Burden – Conceptual Model Lead
- Gayle Reichert/Lisa Costantino – Administrative/ESC Support
- Jacques Kapuscinski – ESC and EPA IT Assistance
- Joe Williams – OW/OA Liaison
- Marilyn Tenbrink – Assistance with Participatory Processes
- Norma Lewis and Sue Schock: Regional Liaisons

Summary

To begin to integrate scientific information with land and resource use decision-maker/stakeholder values we are:

- Increasing our capability
- Documenting what we know (tool database/knowledgebase), what we learn, and what we know we don't know
- Identifying what decision-makers and stakeholders want/need
- Evaluating analytic-deliberative approaches
- Targeting research and tools to meet needs of decision-makers (evolving the conceptual model)

Next Steps

- Coral Reefs Workshops – FY09/FY10
- Complete Version 1 of tools database
- Complete Implementation Plan and Multi-Year Plan revisions
- Begin planning how to evaluate different types of analytic-deliberative approaches
- Work closely with all ESRP teams to ensure our work is complementary
- Strengthen internal partnerships (e.g., Regions, Program Offices, Watershed Central; Landscape Predictive Tools)
- Continue to work with other groups outside of EPA including the Ecosystem-Based Management (EBM) Tools Network and the Planning Collaborative; other agencies
- Increase integration of multiple disciplines (economic network, behavioral and decision sciences, policy-makers, etc)
- Stay informed of new information technology and tools.
- Complete a DSF conceptual model.

Upcoming Presentations/Networking Opportunities

- March 31, 2009. Cincinnati, OH. Decision Analysis: Supporting Environmental Decision Makers Workshop. Presentation given by Ann Vega.
- May 31-June 4 2009. Goteborg, Sweden. SETAC Europe 19th Annual Meeting: Protecting ecosystem health: facing the challenge of a globally changing environment. Platform and Poster presentation. Presentations will be given by Tim Canfield
- July 19-23, 2009, Boston, MA. Coastal Zone Management 09. Building Capacity for Collaborative Decisions, Resilient Ecosystems, and Sustainable Practices: Water, Land, Community and People in Estuarine Watersheds.” Presentation will be given by Marilyn Tenbrink
- September 29-October 1, 2009, Atlanta, GA. ESRP Programmatic Meeting.